
Application engineering

In this section, applications that have significant capacity impact and require engineering are addressed. Suggestions are given for engineering the application for proper operation from a capacity perspective.

Descriptions of features and their functionality are not given here. Please refer to feature documentation in the Northern Telecom Publications.

Remote Virtual Queuing (RVQ) (available with X11 release 18 and later)

Engineering parameters

Several timers are required to control the feature functions on an originating switch. T2, the duration timer for the originator to accept the RVQ offer is not service changeable, and is set to 16 seconds. T6, the duration timer for ring-again at the originating switch is set at 30 minutes. The retry timer, Tx, is user configurable within the range of 2-30 seconds, and is set to a default value of 10 seconds. The retry counter determines the number of times the initial set should be searched before the scanning includes the extended set. It is service changeable and supports values in the range of 4 to 10, with a default value of 5.

Real-time and signaling bandwidth usage depend on the number of retries required before the call is connected. The number of RVQ attempts, in turn, is a function of Tx, the retry counter, and the network topology/route list index. Considering the worst case scenario, assume that only one path is available. The RVQ feature cannot connect a call until the initial busy trunk becomes available.

To solve for the average number of RVQ attempts on a single blocked trunk group, a Markov process model is defined, assuming exponential call holding times and Poisson arrivals of new call attempts. Conditioned on the trunk being busy, the probability that the trunk will still be busy after T_x seconds can be found by numerically solving a system of differential equations. If, after T_x seconds, the call is still blocked, the cycle repeats, so the number of attempts has a geometric distribution with the parameter being the probability of connection after T_x seconds. The average holding time of a trunk call, once it is connected, is 180 seconds. To calculate the arrival rate of call attempts into a trunk, use the relationship

$$\frac{\text{calls} \times \text{holding time}}{100} = \text{CCS}.$$

The holding time used in this calculation should take into account destination busy or trunk busy calls, so the holding time is adjusted to 150 seconds. The busy hour trunk loading of 28 CCS results in an arrival rate of 18.67 calls/hr into a single trunk.

For default values $T_x = 10$ seconds and trunk group size (TGS) 71, the trunk group becomes available after an average of 1.36 RVQ attempts (RVQA), including the final successful attempt. If system parameters deviate significantly from the default values, a more accurate value for the average number of RVQ attempts can be found in [Table 52](#) which assumes the North American T1 standard for which $TGS = (24 \times TL) - 1$. The rows represent values for T_x while the columns give the number of T1 links which make up the trunk group. The intersection of the appropriate row and column provides the corresponding number of RVQ attempts.

Table 52
Average number of attempts for the number of T1 links in the trunk group

		Number of T1 links									
		1	2	3	4	5	6	7	8	9	10
Tx	2	4.80	2.88	2.27	2.00	1.81	1.69	1.61	1.55	1.50	1.46
	4	2.96	2.01	1.71	1.56	1.47	1.41	1.36	1.33	1.30	1.28
	6	2.35	1.72	1.52	1.42	1.35	1.31	1.28	1.25	1.23	1.21
	8	2.04	1.57	1.42	1.34	1.29	1.25	1.23	1.21	1.19	1.18
	10	1.86	1.48	1.36	1.29	1.25	1.22	1.19	1.18	1.16	1.15
	12	1.74	1.42	1.31	1.26	1.22	1.19	1.17	1.16	1.14	1.13
	14	1.66	1.38	1.28	1.23	1.20	1.17	1.16	1.14	1.13	1.12
	16	1.59	1.35	1.26	1.21	1.18	1.16	1.14	1.13	1.12	1.11
	18	1.54	1.32	1.24	1.19	1.17	1.15	1.13	1.12	1.11	1.10
	20	1.50	1.30	1.22	1.18	1.16	1.14	1.12	1.11	1.10	1.09
	22	1.47	1.28	1.21	1.17	1.15	1.13	1.12	1.10	1.10	1.09
	24	1.44	1.26	1.20	1.16	1.14	1.12	1.11	1.10	1.09	1.08
	26	1.42	1.25	1.19	1.15	1.13	1.12	1.10	1.09	1.09	1.08
	28	1.39	1.24	1.18	1.15	1.13	1.11	1.10	1.09	1.08	1.08
	30	1.38	1.23	1.17	1.14	1.12	1.11	1.09	1.09	1.08	1.07

From the RVQA numbers shown in [Table 52](#), it can be seen that the minimum retry counter value, 4, is high enough that searching the extended set of trunks has little or no effect on average system performance except in the case of $TL = 1$ and $Tx = 2$, since the average number of retries is less than the retry counter value.

Another parameter which is not defined as part of the RVQ feature, but which may have a significant effect on overall system performance is the percentage of customers that have RVQ privileges (PRVQP). Let the default value be 100 percent.

Real-time:

For a given switch in a telecommunications network, let l be the average length of the path required to connect trunk calls originating from the switch, where length refers to the number of hops in the path, or, equivalently, the number of tandem trunk groups traversed by a given call. Assume a single path between originating switch and destination switch. Also, assume that customers accept RVQ offers and do not cancel. These assumptions provide worst case estimates. At each trunk group, the probability of blocking (TGB) is assumed to be 0.1. This value is appropriate for private networks which are most likely to invoke the RVQ feature. The average probability of blocking for an outgoing trunk call is given by $(1 - (1 - 0.1)^l)$ or $(1 - 0.9^l)$. If the call is blocked, there must be a minimum of one trunk group along the path that is busy. Choose any busy trunk group. For default values $TGS = 71$ and $Tx = 10$, an average of 1.36 RVQ attempts (RVQA) will be required before that particular trunk group becomes available. Call this the inner loop, with an average duration of 1.36 cycles. Once the trunk group which was busy becomes available, however, at least one other trunk group along the path may be busy with probability $(1 - 0.9^{l-1})$. Define the external loop such that each cycle has a different busy trunk group, compared to the previous cycle. During each cycle of the external loop, an inner loop is required before the busy trunk group becomes available. Assuming a geometric distribution, an average of $1 / 0.9^{l-1}$ cycles will be made before exiting the external loop. Thus, once a call encounters a busy trunk group, the average total number of RVQ attempts required before a call is connected is given by the average number of cycles around the external loop multiplied by the average number of cycles around the inner loop for $(1.36 / 0.9^{l-1})$ total RVQ attempts (TRVQA).

In a private networking environment, typical network calls consist of an originating switch, a tandem switch, and the destination switch, giving a path length $l = 2$. Paths for which $l > 3$ are rare. Let $l = 2$ be the default path length. An average of 1.51 total RVQ attempts is then required for a blocked call to be completed.

Table 53 gives total RVQ attempts for the default path length $l = 2$ for the North American T1 standard.

Table 53
Average total RVQ attempts

		Number of T1 links									
		1	2	3	4	5	6	7	8	9	10
Tx	2	5.33	3.20	2.53	2.20	2.01	1.88	1.79	1.72	1.66	1.62
	4	3.28	2.23	1.90	1.73	1.63	1.56	1.52	1.48	1.45	1.42
	6	2.61	1.91	1.69	1.57	1.50	1.45	1.42	1.39	1.37	1.35
	8	2.27	1.75	1.58	1.49	1.43	1.39	1.36	1.34	1.32	1.31
	10	2.07	1.65	1.51	1.43	1.38	1.35	1.33	1.31	1.29	1.28
	12	1.94	1.58	1.46	1.39	1.35	1.32	1.30	1.29	1.27	1.26
	14	1.84	1.53	1.42	1.37	1.33	1.30	1.28	1.27	1.26	1.24
	16	1.77	1.50	1.40	1.34	1.31	1.29	1.27	1.25	1.24	1.23
	18	1.71	1.47	1.38	1.33	1.30	1.27	1.26	1.24	1.23	1.22
	20	1.67	1.44	1.36	1.31	1.28	1.26	1.25	1.23	1.22	1.22
	22	1.63	1.42	1.34	1.30	1.27	1.25	1.24	1.23	1.22	1.21
	24	1.60	1.40	1.33	1.29	1.26	1.25	1.23	1.22	1.21	1.20
	26	1.57	1.39	1.32	1.28	1.26	1.24	1.23	1.22	1.21	1.20
	28	1.55	1.38	1.31	1.27	1.25	1.23	1.22	1.21	1.20	1.20
	30	1.53	1.36	1.30	1.27	1.24	1.23	1.22	1.21	1.20	1.19

Engineering model

Table 54
RVQ parameters

Parameter	Description	Default value
Tx	retry timer (sec)	10
TGS	trunk group size	71
L	average path length (number of hops)	2
TGB	trunk group blocking probability	0.1
PRVQP	percentage with RVQ privilege	100

System parameters

The system parameters and their default values are listed in [Table 53](#). Several other key values can be derived from these parameters. The number of RVQ attempts which is required before the busy trunk group is available, RVQA, can be found by looking in [Table 52](#). If the average path length $L=2$, the total number of RVQ attempts required before a path is available can be found in [Table 54](#). Otherwise, TRVQA can be calculated using

$$\text{TRVQA} = \frac{\text{RVQA}}{(1 - \text{TGB})^{L-1}}$$

with a default value of 1.51.

The trunk group call arrival rate is given by

$$\text{TGCAR} = 18.67 \times \text{TGS} \text{ calls/hr}$$

or 1325.57 calls/hr in the default case.

The path blocking probability satisfies

$$\text{PB} = 1 - (1 - \text{TGB})^L.$$

Substituting the default values gives 0.19.

The number of RVQ calls per hour (NRVQC) can be calculated by using

$$\text{NRVQC} = \text{TGCAR} \times \text{PB} \times \text{PRVQP}/100.$$

The default value for NRVQC is 251.86 calls. NRVQC provides a measure for the penetration of the RVQ feature.

Real-time model

Since basic trunk calls use 111.31 msec real-time and the RVQ setup and completion time total 202.38 msec, the incremental real-time required by each RVQ call (IRTRVQ) is

$$91.07 + 38.64 \times (\text{TRVQA} - 1).$$

For $T_x = 10$ seconds and $\text{TGS} = 71$, this value is 110.78 msec.

Each RVQ call is equivalent to

$$\frac{\text{IRTRVQ}}{78.49} \text{ EBC.}$$

For the default configuration, the value is 1.41 EBC.

The total incremental real-time requirement is then given by

$$\text{NRVQC} \times \frac{\text{IRTRVQ}}{78.49} \text{ EBC}$$

resulting in 355.12 EBC for the default values.

Signaling link model

The incremental traffic on the signaling link is

$$192 + 121 \times (\text{TRVQA} - 1) \text{ bytes/RVQ call}$$

or 253.71 bytes/RVQ call in the default case. To engineer the signaling link, assume a 70-30 percent direction split on PRI messages and 30 percent spare capacity for traffic peakedness. The incremental bandwidth required for RVQ is then $0.002 \times [192 + (\text{TRVQA} - 1) \times 121]$ bps per RVQ call per hour for a total of

$$\text{NRVQC} \times 0.002 \times [192 + (\text{TRVQA} - 1) \times 121] \text{ bps}$$

for NRVQC RVQ calls per hour. The default value is 127.80 bps.

Trunking model

For each trunk group, the incremental traffic is $NRVQC \times T2/100$ CCS which gives $[(NRVQC \times T2 / 100) / TGS]$ CCS per trunk. The number of additional trunks required for RVQ satisfies

$$\# \text{ additional trunks} = \frac{TGS \times 18.67 \times PB \times T2/100}{28}$$

where 28 CCS is the default busy hour trunk loading value.

For the default values listed in [Table 53](#), 1.44 additional trunks are required due to RVQ.

Meridian Mail (MM)

Meridian Mail traffic calculations and capacity table

Refer to *Site and Installation Planning* (553-7011-200) for a detailed engineering of Meridian Mail, including menu utilization, call duration, storage size, disk size, up requirements, and so on. However, for easy reference, a simplified table is extracted and included here.

Each Meridian Mail Module consists of 16 ports which interface with a DTI type of loop with 24 ports to provide voice channels. In other words, every 16 Meridian Mail ports interface with one ENET loop of 30 timeslots.

As with other traffic calculations, the first step is to determine the average holding time of an MM call. This includes both the time the user is logged on to MM and the time callers are leaving messages for that user. A typical range is 30 to 60 seconds per user depending on the type of application.

The calling rate per MM registered user is about 10 percent of busy hour calls. For example, if a set generates or receives five calls per hour, the MM calls would be 0.5 per hour. If there are 2000 MM users in a switch with average holding time (AHT) of 60 seconds, its MM traffic would be:

$$\text{MM traffic in CCS} = 2000 \times 0.5 \times 60/100 = 600 \text{ CCS.}$$

From [Table 55](#), approximately 23 MM ports are needed for this application.

Note that if complicated voice menus are involved for an application, the AHT needs to reflect that fact.

Table 55
Meridian Mail channel capacity

No. of channels	Capacity in CCS
4	54
8	157
12	273
20	522
24	651
28	782
32	915
36	1049
40	1183
44	1318
48	1455
52	1592
56	1729

Table 55
Meridian Mail channel capacity

No. of channels	Capacity in CCS
60	1867
64	2005
68	2143
72	2282
76	2421
80	2561
84	2700
88	2840
92	2980
96	3120

The main objective to present Meridian Mail engineering procedure here is to show how it fits into the overall Call Center engineering in the later section. For a high level MM port requirements estimate, interpolation or extrapolation between entries is permitted.

The major MM parameter which impacts the real-time capacity of a co-located Meridian 1 is the type of signaling between the MM processor and the Meridian 1 CPU. For locally generated MM calls, CSL and End to End signaling have significant capacity effects, and have different real-time factors as shown in the real-time calculation worksheet.

There are many voice processing features offered with the Meridian Mail application, all of which present unique characteristics in MM usage. Each specific feature, with varying AHT, will impact the MM port requirement differently. This needs to be considered when engineering a specific MM application. The following are known applications of the MM feature: Voice Mail, Voice Menu, Voice Forms, Auto Attendant, Meridian Interactive Voice Response (MIVR), Host Enhanced Voice Processing (HEVP), Network Message Service, and Third Party Voice Messaging Systems.

Meridian Link

Major Meridian Link applications and their real-time impacts are addressed in this section.

Meridian Link data rate determination

Although the subject of signaling link engineering is a part of the *Meridian Link Engineering Guide* (553-3203-151), it will be useful to extract some data from that document to make this engineering guide more complete, since most Call Center applications involve Meridian Link in the configuration.

Table 56
Data Link capacity for typical ACD/AML applications

Link data rate (D) in kbps	64.0	19.2	9.6	4.8	2.4	1.2
Avg. AML calls/hr	82,202	24,660	12,330	6,115	3,057	1,528

The data rate chosen for a link, if it is within the limit of the Meridian 1 CPU capacity, should correspond to an Application Module Link (AML) call capacity value greater than an Meridian 1 is expected to handle.

As long as there are physical I/O ports in the Meridian 1 to interface the AML, there is no practical limit to the number of AML/MLs a system can serve. However, the number of calls corresponding to each application must be added together to determine whether the total is within the CPU capacity of that Meridian 1 system.

The data link requirement for the CCR application is only 3.2 percent higher than for the ML. In other words, the entry in [Table 56](#) should be divided by 1.032 for the CCR application. For example, at 1200 bps rate, the link can handle 1480 CCR calls (= 1528/1.032).

When application modules begin using a common base, all applications sharing the same AML can add up message link call requirements by using the following formula:

$$\text{AML calls/hour} = (\text{Type 1 calls} \times 1.0 + \text{Type 2 calls} \times 1.0 + \dots + \text{CCR calls} \times 1.032)$$

Then, check the AML calls/hour against the data rate requirement in the above table. At this time the only application with factor other than one is CCR. This may change when message usages of more applications are studied.

Incoming AST calls

In an Associated Telephone (AST), the DN of the set is assigned to be controlled by a host. The AST is a set associated with a computer terminal through a database stored in the host. A host, alerted by messages of an incoming call from the Meridian 1, can bring up customer or sales information on the terminal screen while a connection is made to the AST, which is frequently an ACD agent.

Autodialer calls with transfers (Predictive Dialing)

An Autodialer, controlled by a host, directs the Meridian 1 to make a central office (CO) trunk call. When a potential customer answers, the Autodialer detects the connection and transfers the call to an agent to answer. The average holding time of this type of call is relatively short for the Autodialer compare with a conventional call, thus the frequency of calls can be very high. The number of calls successfully transferred is normally a small percentage (5-20 percent) of total Autodialer calls.

Customer Controlled Routing

Customer Controlled Routing (CCR) is an auxiliary product connected to the Meridian 1 via the AML. Depending on the Controlled Direct Number (CDN) of the incoming call, CCR can route calls based on a variety of attributes, such as Calling Line ID (CLID), Dialed Number Identification Service (DNIS), time of call arrival, and the call processing states of the ACD-DN (queue size, agent number, and so on). The CCR can put a waiting call on a maximum of four queues simultaneously. It also provides the flexibility of routing a call to RAN and Music treatments with conditions.

Host Enhanced Routing

The Host Enhanced Routing (HER) feature intercepts an incoming ACD call based on the CDN dialed, and gives the call special treatment according to the script programmed, such as routing to a specific DN queue, connecting to a RAN or Music. It can also make routing decisions based on the conditions of agent load and the service criterion. The real-time impacts of basic CCR and HER features are similar. Depending on the complexity of scripts, either feature can become very sophisticated and real-time extensive.

Direct Autodialer calls (Preview dialing)

An Autodialer connected to a 2500 type line card is controlled by a host through AML to make calls according to a database in the host. This type of call does not involve an ACD agent. The Autodialer either monitors control points by dialing these numbers periodically, as used in factory automation and sales updates, or is connected to a recording machine to perform customer surveys or market research.

Call Center

The Call Center is an ACD switch, whose calls are mostly incoming or outgoing, with extensive applications features, such as CCR, HER, MIVR, HEVP. A port in the Call Center environment, either as an agent set or trunk, tends to be more heavily loaded than other types of applications.

Based on customer application requirements, such as calls processed in a busy hour, and feature suite such as RAN, Music, and IVR, the system capacity requirements can be calculated.

ACD

Automatic Call Distribution (ACD) is an optional feature available with the Meridian 1 system. It is used by organizations where the calls received are for a service rather than a specific person.

For basic ACD, incoming calls are handled on a first-come, first-served basis and are distributed among the available agents. The agent that has been idle the longest is presented with the first call. This ensures an equitable distribution of incoming calls among agents.

The system is managed or supervised by supervisors who have access to the ACD information through a video display terminal. These supervisors deal with agent-customer transactions and the distribution of incoming calls among agents.

Many sophisticated control mechanisms have been built on the basic ACD features. Various packages of ACD features discussed in this NTP will have real-time impact on the Meridian 1 CPU capacity.

ACD-C1 and C2 packages ACD Management Reporting provides the ACD customer with timely and accurate statistics relevant to the ACD operation. These statistics form periodic printed reports and ongoing status displays so the customer can monitor changing ACD traffic loads and levels of service and implement corrective action where required.

The ACD-C1 package primarily provides status reporting of the system through a TTY terminal. To control and alter the configuration of the Meridian 1 system, the ACD-C2 package is required; it provides the load management commands. The following is a partial list of functions of a supervisor position in the C2 package:

- assign auto-terminating ACD trunk routes
- assign priority status to ACD trunks
- reassign ACD agent positions to other ACD DN's
- set the timers and routes for first and second RAN
- define the overflow thresholds
- specify a night RAN route

ACD-D package The ACD-D system is designed to serve customers whose ACD operation requires sophisticated management reporting and load management capabilities. It has an enhanced management display as the Meridian 1 is supplemented by an auxiliary data system. The Meridian 1 and the auxiliary processor are connected by data links through SDI ports for communications. Call processing and service management functions are split between the Meridian 1 and the auxiliary processor.

ACD-MAX ACD-MAX offers a customer managerial control over the ACD operation by providing past performance reporting and current performance displays. It is connected through an SDI port to communicate with the Meridian 1 CPU. The ACD-MAX feature makes the necessary calculations of data received from the Meridian 1 to produce ACD report data for current and past performance reports. Every 30 seconds, ACD-MAX takes the last 10 minutes of performance data and uses it to generate statistics for the current performance displays. The accumulated past performance report data is stored on disk every 30 minutes.

The impact of ACD-MAX calls in the capacity engineering will be in the real-time area only. The Meridian MAX is an AP version of the ACD-MAX which uses an AP module instead of an HP computer as an auxiliary processor. To estimate the impact of MAX on the Meridian 1 CPU, both versions can be treated the same.

NACD

The majority of tasks in the engineering of Network ACD (NACD) involve the design of an NACD routing table and the engineering of overflow traffic. The process is too complex to be included here. The engineering procedure in this NTP is for single node capacity engineering, which accounts for the real-time impact of NACD calls on a switch either as a source node or remote target node. Therefore, the overall design of a network is not in the scope of this document.

MIVR

The Meridian Interactive Voice Response (MIVR) is a Meridian Mail application in which a third-party module (Voicetek™ machine) controls the operation of an MM through the 9600 baud ACCESS link. The communication between the Meridian 1 and MM continues to use the CSL. Voice ports required for the MIVR feature are MM ports.

In order to provide a balanced configuration among trunks, MIVR ports (or MM ports), and agents in the Meridian 1 overall configuration, a brief summary of some provisioning requirements are in order:

- 1 Physically, the MIVR port is the same as the MM port, except that it is controlled by the MIVR application module through the 9600 baud ACCESS link (an asynchronous link). The provisioning of MIVR ports is a multiple of 24, just like MM ports. In MIVR release 1, with one ACCESS link, 48 MIVR ports are the maximum. In release 2, a second ACCESS link will be permitted, which can support another 16 MIVR ports.
- 2 The data link, CSL, which provides signaling between the Meridian 1 and Meridian Mail, is always a 4800 baud synchronous link.
- 3 The distribution of Holding Times (HTs) for MIVR ports are bimodal, one short HT for calls that are transferred to live agents and one long HT for calls that are served by the MIVR menu.
- 4 The long HT call occupies a trunk circuit just like any other ACD call. The short HT call has an incremental impact on trunk occupancy. The average HT of a trunk is equal to the sum of the MIVR HT and the agent HT. In other words, all transferred MIVR calls have an incremental impact on trunking requirements.
- 5 If the default short HT on the MIVR port is 15 seconds, the additional CCS to trunk can be estimated as follows: Incremental MIVR CCS to trunks = Transferred MIVR calls x 15/100.

Host Enhanced Voice Processing

The Host Enhanced Voice Processing (HEVP) feature is similar to the MIVR except that the ACCESS link is replaced by a Meridian Mail link, and the voice processing is controlled by the Meridian Application Module instead of a Voicetek machine.

An HEVP call involves the AML to control a voice mail treatment; its real-time impact on the Meridian 1 is like a combined MM and AML call. HEVP real-time impact can be treated like the MIVR.

Meridian 911

The primary difference between the M911 application and other Application Module link related incoming ACD calls is the requirement of MF Receivers (MFR), which interpret digits received from CO through MF trunks for M911 calls.

The following procedure should be followed to estimate the MFR requirement:

- 1** Calculate the number of calls from MF trunks:

$$\text{M911 calls} = \text{No. of MF trunks} \times 28 \times 100/180 = 15.56 \times \text{No. of MF trunks.}$$

where the default value of CCS for the trunk is 28 and the average holding time is 180 seconds. These numbers should be replaced by specific values at your site if they are available.

- 2** Calculate MFR traffic:

$$\text{MFR traffic in CCS} = \text{M911 calls} \times 6/100$$

where the ANI digits of 8 were estimated conservatively to hold up a receiver for 6 seconds.

- 3** Refer to *Feature Group D description and operation* (553-2901-102) to find the requirements of MFRs. For the purpose of estimating MFR requirements, the DTR table can be applied. Read the number of DTRs (MFRs) corresponding to a CCS entry greater than the above calculated CCS value under the column of 6-second holding time. An abbreviated table is shown here for simple reference.

Table 57
MFR table with 6-second holding time

No. of MF receivers	2	4	6	8	10	15	20	25	30	35	40
Capacity in CCS	3	24	61	106	157	300	454	615	779	947	1117

RAN and Music

The RAN trunk can be treated just like a normal trunk. The only potential capacity impact is for small systems (options 21 and 61) which may need to include RAN trunks in blocking or non-blocking calculations to determine the total number of loops or card slots required. Refer to “Service loops and circuits” on page 63 to calculate RAN requirements.

Music in Meridian 1 is provided by broadcasting a music source from a RAN trunk to a conference loop. Therefore, a maximum of 30 users can listen to music at one time. If this is not sufficient, an additional conference loop needs to be provided for each additional 30 simultaneous music users.

The conference loop connects to one half of the TDS/CON card. The second conference loop, if needed, will take another card and card slot, because it cannot be separated from the TDS loop.

Other features

Features such as CCR, HER, and Predictive Dialing are as much a Call Center feature as an AML one. However, since they were already discussed under the Meridian Link umbrella, they will not be repeated here.

Call Center examples

Real time factors used in the following examples are based on Release 21 numbers. The same method and procedures can be applied to later releases with new and updated real time factors.

A basic Call Center with MIVR

Model: 64 agents, 5 supervisors, 65 PRI trunks, 15 analog trunks. 1600 calls per hour required. All incoming calls terminate on 24 MIVR ports. 70 percent of calls are transferred to live agents after listening to messages for 15 seconds, the rest are satisfied with voice menu information. Fifty administrative sets (all digital) with 6 CCS per set handle non-ACD calls. Meridian Mail is used for administrative traffic. Average holding time is 132 seconds for all serviced calls.

Solution:**1** Loop requirement**Table 58**
Worksheet for network loop calculation (example) (Part 1 of 2)

Column A		Column B (Loops)
TDS/CON loops	One card (2 loops) per Network Module*	__2__
BLOCKING:		
ENET loop	Admin. sets	__50__ x 6 = __300__ CCS
	Non-ACD trunks	
		+ ____ x 26 = ____ CCS
	Subtotal	= __300__ ÷ 660 = __1__ (N _{0e})
XNET loop	Admin. sets	____ x 6 = ____ CCS
	Non-ACD trunks	+ ____ x 26 = ____ CCS
	Subtotal	= ____ ÷ 875 = ____ (N _{0x})

Table 58
Worksheet for network loop calculation (example) (Part 2 of 2)

Column A			Column B (Loops)
NON_BLOCKING: (ENET or XNET)			
Agent sets	_____64_____		
Supervisor sets	+ _____5_____		
ACD analog and RAN trunks	+ _____15_____		
Subtotal	= _____84_ ÷ 30		= _____3____(N ₁)
DTI Trunks	= _____ ÷ 24		= _____(N _{2d})
PRI Trunks	_____65_____		
	+ 2		
	= _____67_ ÷ 24		= _____3____(N _{2p})
Music ports	= _____ ÷ 30		= _____(N ₃₁)
MM/MIVR/HEVP ports	_____24_ ÷ 16		= _____2____(N ₃₂)
Total loops (Sum of entries under column B)			= _____11____(N _L)
Note: All calculations should be rounded up to the next integer. * Iterative procedure may be needed, if the number of network modules required was not correctly estimated at the outset. Conclusion: $N_L \leq 26$ option 21 $16 < N_L \leq 32$ option 61 $32 < N_L \leq 160$ option 71/81			

TDS/CON loops = 2 one Network Module is initially estimated
 $N_0 = [50 \times 6/660] = 1$ loops for admin. sets
 $N_1 = [(64 + 5 + 15)/30] = 3$ loops for agent, supervisor sets and trunks
 $N_{2p} = [(65 + 2)/24] = 3$ loops for PRI trunks
 $N_{32} = [24/16] = 2$ loops for MM (MIVR) ports
 Total required loops = $2 + 1 + 3 + 3 + 2 = 11$

An option 21 can have up to 26 loops. Therefore, loop capacity in option 21 is not a limitation for this configuration. Our initial estimate of one Network Module was correct.

2 Card slot requirement

Table 59
Worksheet for option 21* card slot calculation (example)

Column A (Loop/card)		Column B (Slots)
TDS/CON	One/Network Module	= <u>1</u>
Music loop	One TDS/CON provides one MUSic	= <u>(N₃₁)</u>
QPC414 ENET	Blocking Loops	<u>1</u> (N _{0e})
	DTI Loops	+ <u>(N_{2d})</u>
	PRI Loops	+ <u>3</u> (N _{2p})
	MMail Loops	+ <u>1</u> (N ₃₂)
	Subtotal	= <u>5</u> ÷ 2 = <u>3</u>
Clock Controller	= 1 (If N ₂ > 0; else = 0)	= <u>1</u>

Table 59
Worksheet for option 21* card slot calculation (example)

Column A (Loop/card)		Column B (Slots)
NT8D04 XNET	Blocking Loops	_____ (N_{0x})
	Nonblocking Loops	+ ____ 3 ____ (N_1)
	Subtract 4 for NT8D18 NET	- ____ 4 ____
	Subtotal	= ____ 0 ____ ÷ 4 = ____ 0 ____ (S_x)
NT8D18 NET/DTR	= 1 (always equipped)	= ____ 1 ____
I/O cards**	Must be $\geq S_x$	= ____ 1 ____
QPC720 DTI/PRI	= $2 \times N_2$ if no NT8D35 module; else = 0	= _____
Total # of card slots (Sum of entries under column B)		= ____ 7 ____ (S_c)
Conclusion: $S_c \leq 7$ option 21 $7 < S_c \leq 16$ option 61 $16 < S_c$ option 71/81		
Note: All calculations should be rounded up to the next integer. A negative loop number should be set to zero.		
*Iterative procedure may be needed, if using option 21 or 61 was not clear at the outset.		
**Refer to Table 3 to find the number of I/O cards needed for applications.		

Without using NT8D35 Network Modules, the PRI ENET alone will require seven card slots. Therefore it is not a viable option.

$TDS/CON = 1$

$[(N_{0e} + N_{2p} + N_{32})/2] = [5/2] = 3$ all ENET loops are lumped together

A CC slot needed for option 21 = 1 assumed option 21 is the candidate

$[N_1/4] = [3/4] = 1$ XNET loops treated separately

I/O card slot = 1 one MSDL is enough for MIVR and Meridian Mail

Total slots, $S_c = 1 + 3 + 1 + 1 + 1 = 7$.

With a supporting NT8D35 Network Module, the configuration requires seven network card slots, which is equal to the maximum number of card slots available for an option 21 network module (NT8D11 CE/PE Module). Therefore, this configuration is within the limits of an option 21.

3 Real-time Requirement

The real-time worksheet used here is slightly modified for Call Center applications. An ACD call has the real-time components of a basic call (1.0), digital set (0.14), inbound ACD call (0.59). The supervisor set calls are added to ACD calls without advanced features, for example, MIVR. The administrative set calls (114) are added to basic calls and digital set calls. The 20 percent real-time factor for the basic feature package is eliminated for special applications like Call Center.

Feature	Usage	×	Real Time Factor	=	EBC
Busy hour calls	1760	×	1.00	=	1760
500, 2500 set calls		×	.00	=	
SL-1 set calls		×	.14	=	
Digital set calls	1760	×	.14	=	246
BRI voice calls		×	.12	=	
Data calls		×	.14	=	
CPND characters		×	.01	=	
CDP calls		×	.05	=	
MM (CSL) calls	12	×	1.05	=	13
MM (EES) calls		×	4.12	=	
NMS (Main) calls		×	1.19	=	
NMS (Remote) calls		×	2.75	=	
Auto Attendant calls		×	1.36	=	
ACD (Inbound) calls	1646	×	.14	=	231
ACD (outbound) calls		×	.50	=	
ACD-D/MAX calls		×	.81	=	

Feature	Usage	×	Real Time Factor	=	EBC
NACD overflowed calls		×	2.89	=	
Meridian link calls		×	.38	=	
MLink status messages		×	.57	=	
MLink call transfers		×	1.72	=	
HER calls		×	1.31	=	
CCR calls - simple script		x	1.31	=	
CCR calls - medium script		x	2.63	=	
CCR calls - complex script		x	3.94	=	
Predictive dialer		×	1.72	=	
MIVR without transfer	1600	×	0.51	=	816
MIVR with transfer	1120	×	1.78	=	1994
Internal CDR calls		×	1.49	=	
Outgoing CDR calls		×	1.09	=	
Incoming CDR calls		×	1.25	=	
Authorization code calls		×	.85	=	
Off-Hook Queuing calls		×	.47	=	
Trunk Calls, incoming DTN	304	×	.11	=	33
Trunk Calls, incoming DIP		×	.11	=	
Trunk Calls, outgoing TIE		×	.390	=	

Feature	Usage	×	Real Time Factor	=	EBC
Trunk Calls, outgoing CO		×	.15	=	
RAN messages		×	.03	=	
Music		×	.37	=	
BARS/NARS calls		×	.06	=	
NFCR calls		×	.08	=	
DTI calls, incoming		×	.30	=	
DTI calls, outgoing			.55	=	
PRA calls, incoming	648	×	.16	=	104
PRA calls, outgoing	648		.22	=	143
RVQ calls		×	1.41	=	
Superloop calls		×	-.20	=	

Total real-time impact (add up the EBC column) EBC = 5339.

The user should have calculated the number of calls for each feature according to procedures in earlier sections before using the worksheet. Calculations of entries in the worksheet are explained by the following procedure and equation.

Fill in the numbers of featured calls applicable to a specific configuration in the worksheet.

Supervisor set calls = $5 \times 9.2 = 46$ calls

Adm. set EBC = $(50 \times 6/1.32) \times 0.5 = 114$ calls

Basic Call EBC = $1 \times (1,600 + 46 + 114) = 1,760$ EBC

Digital set calls = $1760 \times 0.14 = 246$ EBC

ACD inbound EBC = $(1,600 + 46) \times 0.14 = 230$ EBC

MIVR EBC = $1,600 \times 0.51 = 816$ EBC

MIVR with transfer EBC = $1,600 \times 0.7 \times 1.78 = 1994$ EBC

Meridian Mail Call EBC = $114 \times 1.05 \times 0.1 = 12$ EBC (assumed 10 percent of originating/terminating calls being diverted to MMail boxes and later retrieved, and the MM is using CSL signaling).

Out of 1600 calls, about 81 percent ($= 65/(65 + 15)$) or 1296 calls are from PRI trunks, the rest (304) from DTN trunks.

DTN trunk calls EBC = $304 \times 0.11 = 33$

Incoming PRI trunk calls EBC = $648 \times (.16) = 104$

Outgoing PRI trunk calls EBC = $648 \times (.22) = 143$

Total system EBC = 5,498

Percent CPU usage = $5,498/5,800 = 94.7\%$

Spare CPU capacity = $(5,800 - 5,498)/5,800 = 5.3\%$

The holding time on MIVR ports will impact the number of MIVR/MM ports provided and incoming trunks required; it will not affect the loading on the Meridian 1 CPU.

4 Result

This Call Center can be served by an option 21 Meridian 1. However, the CPU has a spare capacity of 5.3 percent when fully loaded.

To keep this section short, the loop, card slot, and real-time worksheets will not be used in the following examples, instead the calculation procedure is used.

A Call Center with Meridian Link and Predictive Dialing

Model: 23 inbound agents, 4 outbound agents, 3 supervisors. 64 PRI trunks, 8 analog trunks. Center must support 500 inbound calls and 1500 outbound calls per hour. The outbound calls are placed by 30 2500-type lines, controlled by a predictive dialing application connected through Meridian Link to a host and the Meridian 1. Only 5 percent of calls are answered and transferred to a live agent. All inbound calls are controlled by CCR. There are 50 administrative digital sets with 6 CCS per set. Average holding time per call is 150 seconds. Also determine the data link requirements.

Solution:

1 Loop requirement

TDS/CON loops = 2 the initial estimate of TDS/CON card is one

$N_0 = [(50 \times 6 + 8 \times 28)/875] = 1$ 8 analog trunks are placed in this loop

$N_1 = [(23 + 4 + 3 + 30)/30] = 2$ autodialer ports also require nonblocking

$N_{2p} = [(64 + 2)/24] = 3$ loops for PRI trunks

Total network loops required = $2 + 1 + 2 + 3 = 8$. It is within the capability of an option 21. For regular traffic, the CCS can be divided by either 660 or 875 CCS to determine the number of loops needed. It ultimately is decided by whether IPE or EPE has spare loops for this type of traffic without requiring another card slot. In this example, all non-PRI/DTI loops are using IPE.

2 Card slot requirement

We will deal with the case including NT8D35 Network module only, since a system without a supporting module can handle no more than two PRI's. The calculation for card slots is as follows:

TDS/CON = 1	assumed one Network Module is enough
$[N_{2p}/2] = 2$	slots for PRI ENET loops
CC in option 21 = 1	assumed that the candidate system is an option 21
$[(N_0 + N_1)/4] = 1$	an IPE superloop is proposed
I/O card slot = 1	an MSDL is sufficient for DCHI and ESDI (CCR)
$S_c = 1 + 2 + 1 + 1 + 1 = 6$. the required card slot is equal to 6 (<7), it is within the capacity of an option 21.	

3 Real-time requirement

Supervisor telephone calls = $3 \times 9.2 = 28$

Administrative telephone calls = $(50 \times 6/1.5) \times 0.5 = 100$

Basic Call EBC = $(500 + 1,500 + 28 + 100) \times 1 = 2,128$ EBC

Digital set EBC = $(500 + 28 + 100) \times 0.14 = 88$ EBC

Incoming ACD EBC = $(500 + 28) \times 0.14 = 74$ EBC

CCR EBC = $500 \times 1.31 = 655$ EBC

Outgoing ACD EBC = $1,500 \times 0.50 = 750$ EBC

Predictive Dialing EBC = $1,500 \times 0.05 \times 1.72 = 129$ EBC

Outgoing trunk calls EBC = $1500 \times 0.03 = 45$ EBC; assumed CO trunks

Incoming PRA EBC = $500 \times 0.16 \times (64/(64 + 8)) = 71$ EBC

Outgoing PRA EBC = $1,500 \times 0.22 \times (64/(64 + 8)) = 293$ EBC;
PRA calls are proportional to the total trunks.

Total EBC used = $2,128 + 88 + 74 + 655 + 750 + 129 + 45 + 71 + 293$
= 4,233

Percent CPU usage = $4,233/5,800 = 73\%$

4 Data link requirements

The number of Predictive Dialer calls is 1500, which is less than 1528 (call capacity of a 1200 baud link). Therefore, the ML requires a data rate of 1200 baud. Similarly, the number of CCR calls is less than 1480, hence, another link of 1200 baud is sufficient. Note that for systems before X11 release 20 for which a common platform for ML and CCR is not available, two separate links are needed for this Call Center. With co-residency, one link of 2400 baud is able to handle all signaling traffic of this application.

5 Result

The required configuration can be handled by an option 21. The projected CPU load is 68 percent of the rated capacity. Two data links at 1200 baud each are needed for ML and CCR applications.

A Networked Inbound Call Center

Model: 73 agents, 5 supervisors, 64 PRI trunks, 22 analog trunks. There are also 21 TIE trunks to two other centers through NACD interflow. Center must support 2000 inbound calls per hour. 25 percent of calls are interflowed to the two other centers. There are 48 administrative sets with 6 CCS per set. Meridian Mail (8 ports) is used for non-ACD application. A MAX is included in the Center, every call has a CDR record and 35 percent of calls served have to go through RAN (8 trunks) and Music (30 ports) while queuing. Average holding time per call is 120 seconds.

Solution:

1 Loop requirement

TDS/CON loops = 2	assumed one module (option 21)
$N_0 = [(48 \times 6 + 21 \times 26)/660] = 2$	admin. sets and tie trunks are lumped together
$N_1 = [(73 + 5 + 22 + 8)/30] = 4$	loops for agents, analog and RAN trunks
$N_{2p} = [(64 + 2)/24] = 3$	loops for PRI trunks
$N_{31} = [30/30] = 1$	loops for Music
$N_{32} = [8/24] = 1$	loops for Meridian Mail ports
Total loops required = 2 + 2 + 4 + 3 + 1 + 1 = 13	

The loop requirement can be met by an option 21.

2 Card slot requirement

Again, with PRI trunks, we will consider only the case with the NT8D35 Network Module included.

$$\text{TDS/CON} = 1$$

$$[N_0/2] = 2/2 = 1$$

ENET loop is proposed for regular traffic

$$[N_1/4] = 4/4 = 1$$

a full superloop for high traffic ports

$$[(N_{2p} + N_{32})/2] = [(3 + 1)/2] = 2$$

slots for EPE loops (PRI and Meridian Mail)

$$\text{CC in option 21} = 1$$

tentatively assumed using option 21

$$\text{Card for Music} = 1$$

the CON of the second TDS/CON for Music

$$\text{I/O ports slots} = 2$$

2 MSDL for 2 DCHIs, Meridian Mail, Meridian MAX, and CDR

$$S_c = 1 + 1 + 1 + 2 + 1 + 1 + 2 = 9$$

This card slot requirement exceeds the capacity of an option 21. Therefore, an option 61 is needed.

3 Real-time requirement

Supervisor telephone calls = $5 \times 9.2 = 46$

Administrative telephone calls = $48 \times 6/1.2 \times 0.5 = 120$

Basic Call EBC = $(2,000 + 46 + 120) \times 1 = 2166$ EBC

Digital set EBC = $(2,000 + 46 + 120) \times 0.14 = 303$ EBC

Incoming ACD EBC = $(2,000 + 46) \times 0.14 = 286$ EBC

NACD Overflowed Call EBC = $2,000 \times 0.25 \times 2.89 = 1445$ EBC

RAN/MUS traffic in EBC = $2,000 \times (1 - 0.25) \times 0.35 \times (0.37 + 0.46)$
= 436 EBC

MAX EBC = $2,000 \times 0.81 = 1,620$ EBC

CDR Record (inc.) EBC = $2,000 \times 1.25 = 2,500$ EBC

Meridian Mail Call EBC = $120 \times 1.05 \times 0.1 = 13$ EBC (assumed
10 percent of non-ACD calls being diverted to MMail boxes and with
CSL signaling)

Incoming DTN trunk EBC = $2,046 \times 0.11 = 225$ EBC

Outgoing tie trunk EBC = $2,000 \times 0.25 \times 0.15 = 75$ EBC

Incoming PRA calls EBC = $2,046 \times (64/(64 + 22)) \times (-0.16) = 244$ EBC

Total EBC used = $2,166 + 303 + 286 + 1445 + 436 + 1,620 + 2,500 + 13 +$
 $225 + 75 + 244 = 9,313$ EBC

Percent CPU usage = $9,313/22,500 = 41\%$

Since we are using option 61 due to the card slot requirement, the EBC of 22,500 from Real-time Capacity Table for option 61 is used. Note that even if there is no card slot limitation, the number of required EBC (9,313) exceeds the option 21's capacity of 5,800 EBC. The system will require a larger system than an option 21.

4 Result

The required configuration exceeds the capacity of an option 21 in both card slot and real-time limitations. Therefore, an option 61 is required which will provide plenty of spare capacity for future growth.

Inbound Call Center with MIVR

A Call Center with 285 agents, 30 supervisors, 565 trunks of which 358 are digital. All calls go to IVR first. Meridian IVR has 5 ACD DN's, 64 agents (simultaneous sessions), and is connected through cluster controllers to an IBM mainframe. Assume that 80 percent of calls are transferred to live agents, 20 percent remain in IVR. Assume average holding time in MIVR for transferred calls is 10 seconds, and held calls is 120 seconds. Average live agent ACD call holding time is 132 seconds. The Center must support 7,000 calls per hour on the ACD side.

Assume that CCR controls 70 percent of the calls transferred to live agents from the MIVR, with the rest coming straight into ACD DN's. There are also 100 administrative sets, with an average load of 6 CCS per set for both internal and external calls. Meridian Mail is used for internal and external purposes by administrative telephone calls, which share ports with the MIVR.

Solution:**1 Loop requirement:**

TDS/CON loops = 6

3 Network Modules are needed; this number is re-calculated after the first NL had been obtained

$N_0 = [(100 \times 6)/660] = 1$

loops for admin. telephones

$N_1 = [(285 + 30 + 207)/30] = 18$

loops for agents, supervisors, analog trunks

$N_{2p} = [(358 + 2)/24] = 15$

loops for PRI trunks

$N_{32} = [64/16] = 4$

loops for MIVR ports; the MIVR R1 has a capacity of 48 ports, R2 will have 64

$N_L = 6 + 1 + 18 + 15 + 4 = 44$

43 loops are required for this application

The configuration requires an option 71 or 81 with at least two network groups (or three Network Modules). Because an option 71/81 is to be used, no checking on the card slot limitation is needed.

2 Real-time requirement:

Total calls to MIVR and the system = $565 \times 15.6 = 8814$ calls/hour (assumed 15.6 calls per trunk). In this example, the offered calls to the system are defined by the number of fully loaded trunks, not calls handled by agents and supervisors. Since calls from trunks should include everything, the supervisor sets will not add additional calls to the total trunk calls.

Admin set calls = $100 \times 6 \times 0.5 \times 100/120 = 250$ (120 seconds HT for admin sets)

Basic call EBC = $(8,814 + 250) \times 1 = 9,064$

Digital set calls = $9,064 \times 0.14 = 1,269$

ACD EBC = $8,814 \times 0.14 = 1,234$

MIVR EBC = $8,814 \times 0.51 = 4,495$

MIVR with transfer EBC = $(8,814 \times 0.8) \times 1.78 = 12,551$

CCR calls EBC = $(8,814 \times 0.8) \times 0.7 \times 1.31 = 6,466$

EBC for MMail = $250 \times 0.1 \times 1.05 = 26$ (10 percent of admin calls go to MM)

RAN/MUS EBC = $(8814 \times 0.8) \times 0.7 \times 0.2 \times 0.83 = 819$ (20 percent of CCR calls require RAN/MUS)

Incoming trunk calls EBC = $8814 \times 0.11 = 970$

PRA trunk calls EBC = $8814 \times (358/565) \times (0.16) = 894$

Total system EBC = $9,064 + 1,269 + 1,234 + 4,495 + 12,551 + 6,466 + 26 + 819 + 970 + 894 = 37,788$

This EBC exceeds the CPU capacity of an option 71. An option 81/61C/51C is required.

Percent CPU utilization (option 81/61C/51C) = $37,788/49,400 = 76\%$

3 Result

This configuration exceeds option 61 in physical requirement, and option 71 in real-time capacity (22,500). However, it can be handled by an option 81 with about 76 percent loading on the CPU.

A Call Center with HEVP

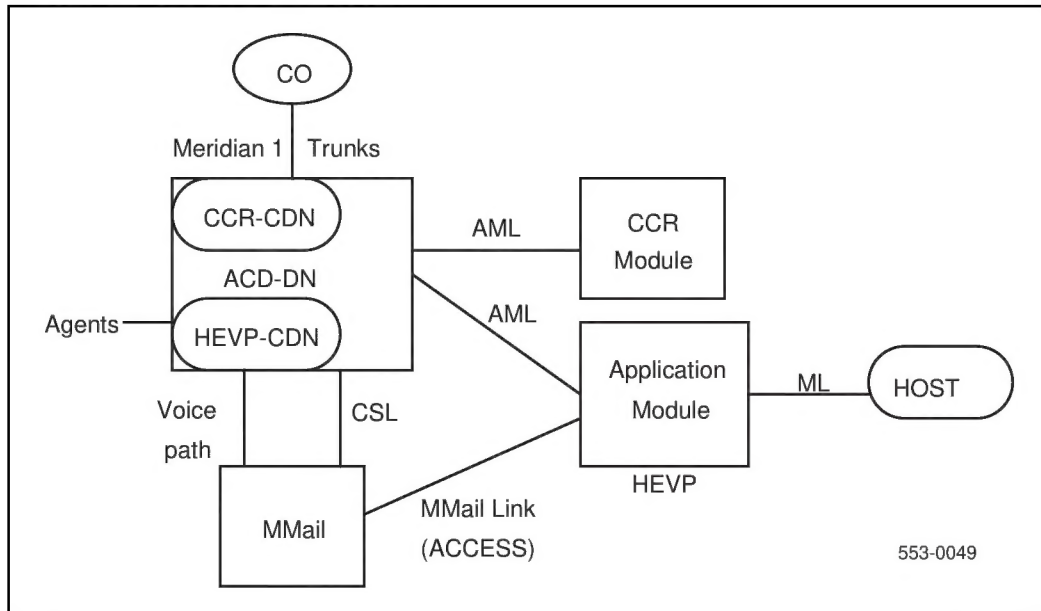
Model: A Call Center with 480 agents, 50 supervisors, 760 trunks of which 510 are PRI. 20 percent of all calls go to HEVP CDN first, half of them use voice menu for 90 seconds and disconnect; the other half will transfer to live agents after using voice ports for 20 seconds and be served. 60 percent of the remaining total calls will terminate on ACD DN's, the remaining 40 percent will terminate on CCR CDNs. Assume that the average service time of a call by live agent is 180 seconds regardless of its source. Although there are some shorter calls, because of queues, average holding time per trunk is also 180 seconds.

Questions to be answered:

- Is this configuration within the loop capacity of a Meridian 1?
- How many incoming calls are to be processed in this scenario?
- How many MM ports are needed to serve this HEVP?
- Which option of Meridian 1 is needed to handle this configuration and at what level of CPU load?
- What data rates are required at various signaling links?

The block diagram of a typical HEVP application is given in [Figure 10](#). Note that a common platform for CCR and HEVP applications is not available before X11 release 20.

Figure 10
A simplified HEVP configuration



Solution: This scenario is simplified to concentrate on HEVP related issues only. Other applications demonstrated earlier can be superimposed on the HEVP feature to give a complete picture of a Call Center application.

We will deal with the questions one by one:

1 Loop capacity

The information to determine loop requirement is not complete until we know how many voice ports on the MM are needed. Item 3 in this solution text indicates 44 ports are needed.

The required number of loops are:

TDS/CON loops = 8

re-calculated after initial estimate

$N_1 = [(480 + 50 + (760 - 510))/30] = 26$

either IPE or EPE will do

$N_{2p} = [(510 + 2)/24] = 22$

card slots for PRI loops

$N_3 = [44/16] = 3$

Meridian Mail ports based on HEVP port calculation (item 3 below)

$N_L = 8 + 26 + 22 + 3 = 59$

Physically, the system has to be a 2-group (4 Network Modules) option 71 or 81. There is no need to check card slot limitations for a large system.

2 Total system calls

The default CCS per trunk is 28, therefore, calls per trunk is 15.56 (= 28/1.8).

Total incoming ACD calls/hour = $760 \times 15.56 = 11,826$.

HEVP CDN calls = $11,826 \times 0.2 = 2365$

HEVP calls with transfer = $2365 \times 0.5 = 1183$

CCR CDN calls = $11,826 \times (1 - 0.2) \times (1 - 0.6) = 3784$

3 HEVP ports

Traffic calculation:

$CCS = (2369 \times 0.5 \times 90 + 2369 \times 0.5 \times 20)/100 = 1066 + 237 = 1303$

From [Table 55](#), 44 voice ports are needed to handle 1303 CCS.

4 CPU loading

Basic Call EBC = $1 \times 11,826 = 11,826$

Digital set calls EBC = $11,826 \times 0.14 = 1,656$ (assumed all digital)

ACD EBC = $11,826 \times 0.14 = 1,656$

HEVP EBC = $2,365 \times 0.51 = 1206$ (used MIVR factors for HEVP)

HEVP with transfer EBC = $1,183 \times 1.78 = 2,106$

CCR EBC = $3,784 \times 1.31 = 4,957$

Incoming trunk calls EBC = $11,826 \times 0.11 = 1,301$

PRA calls EBC = $11,826 \times (510/760) \times (0.16) = 1,270$

Total system EBC = $11,826 + 1,656 + 1,656 + 1,206 + 2,106 + 4,957 + 1,301 + 1,270 = 25,978$

Percent CPU usage = $25,978 / 22,500 = 115\%$

Option 71 with call capacity of 22,500 EBC (from Table 14) will not be able to handle this configuration.

5 Signaling link requirements

According to [Table 56](#), 3,784 CCR calls require a data link of 4800 baud. 2365 HEVP calls need a data link of 2400 baud. The ACCESS link (Meridian Mail Link) is a fixed 9600 baud link. The CSL link is also a fixed 4800 baud link.

Configuration Parameters

Design parameters are constraints on the system established by design decisions and enforced by software checks. A complete list is given in the Appendix, with default values, maximums and minimums, where applicable. Although defaults are provided in the factory installed database, the value of some of these parameters are to be set manually, through the OA&M interface, to reflect the actual needs of the customer's application.

For guidelines on how to determine appropriate parameter values for call registers, I/O buffers, and so on, see "Mass storage size" on page 115.